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Late Season Stripe Rust Damage: Head Infection and Unpredicted Variety Responses

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Cool and moist conditions during October in parts of eastern Australia contributed to a resurgence in stripe rust activity. Certain triticale varieties became unexpectedly and severely infected, and this included significant infection of the spike. In situations where spike infection was severe, serious crop losses are anticipated.

An Unpredictable Season

Seasonal conditions in 2009 throughout the Australian winter cereal regions have been variable, with early hopes dashed in some areas and surprising above average rain in winter giving prospects for excellent harvests across regions that initially seemed set for another disappointing year. Summer rainfall gave Queensland and northern NSW an excellent start to 2009. However warm conditions in September and less than expected rainfall left some growers experiencing a disappointing finish. Nevertheless there were many good crops in this region that established early and picked up sufficient in-crop rainfall to realize above average yields. Further south (south west slopes and Riverina in NSW), conditions have been much more difficult with insufficient subsoil moisture and declining rainfall leading to below average yield expectations and crop failure in some districts. The regions south and east of Wagga Wagga have been the exception in this region with good rainfall and cool conditions during flowering and seed set. Stripe rust in these situations has persisted and fungicides continued to be deployed to ensure yield capture.

The Victorian Wimmera, Western Districts and High Rainfall zones have experienced an above average season with good prospects for an excellent harvest. A similar situation could be described for the SE region of South Australia. The Mallee (Victoria and South Australia), the Mid North and Eyre Peninsular regions of South Australia, and Western Australia in general, have all experienced good seasonal conditions with prospects for above average yields. The national wheat harvest is predicted to be of the order of 23 million tonnes, representing a potential increase of several million tonnes over the previous

season. However, unprecedented prolonged hot temperatures in recent days through South Australia and Victoria may yet prove to reduce yield expectations.

Stripe rust has been problematic again in eastern Australia, although the industry is generally more seasoned and prepared in responding to outbreaks. The Western Australian region experienced little stripe rust damage in 2009, due in large part to minimal over-summer survival under hot dry conditions.

Variety Responses to Stripe Rust

The responses of varieties to stripe rust have been generally in accord with predictions published in sowing guides. Nevertheless, some surprises have again surfaced in variety responses and these have in some part reflected pathotype distribution.

Yr17 Wheats: Current results from the pathotype survey (Table 1) confirm early reports this season that the 'WA Yr17' pathotype has dramatically increased in frequency compared to previous years. This explains in part the more widespread concern with wheats carrying *Yr17* that are known to be vulnerable to this pathotype, *ie* Barham, Bowie, Derrimut, Fang, Hornet, Mace, Marombi, Pugsley, QAL 2000, QAL Bis, Sunstate, Trident, Ventura, Yenda, Young. The response of these and other *Yr17* varieties will be reviewed at the end of the season as reports indicate that several of these are more vulnerable than earlier anticipated.

Yr27 Wheats: The 'Jackie Yr27' pathotype has not been recovered in 2009, despite several stripe rust samples collected from GBA Ruby. It is therefore expected that wheats carrying *Yr27* (*viz.* GBA Ruby, GBA Hunter, Livingston, Mira, Merinda, Waagan, Zebu) should remain resistant in the current season.

Correll: This variety was released in 2006 as a replacement for the popular variety Yitpi, but with improved stem rust resistance. It has a rating of MR-MS for stripe rust, which represents a similar expectation to its parent Yitpi. Higher than expecetd levels of disease were observed in South Australia in late August, particularly in hot spots. Isolates were collected and shown to be the 'WA Yr17' pathotype that was initially common in South Australia. Experiments were then conducted to test the hypothesis that an adult plant resistance in Correll (and by implication Yitpi) may have been overcome by a change in the pathogen. Independent tests carried out at SARDI (Hugh Wallwork and colleagues) and PBI Cobbitty failed to demonstrate evidence to support the hypothesis. The conclusion is that Correll may show high levels of disease in hot spot situations, but this has not translated to widespread disease through the crop. This situation has been similar in many varieties which show evidence of more severe reactions in hot spots that typically result from multiple pathogen cycles during mid to late winter when spore masses remain heavy and therefore infections become localized leading to high inoculum loads.

Lincoln: This variety was released in 2007 and has performed well as a main season variety in southern NSW, Victoria and South Australia. Lincoln is resistant to stripe rust and it is likely that at least part of the resistance is based on the gene *Yr4*. Several rust samples have been received from Lincoln in the past month, and these will be tested on a source of *Yr4.* At the time of writing, pathotype determinations on the Lincoln stripe rust samples have not been completed.

Triticales: The occurrence of the 'Jackie' pathotype since 2007 has resulted in increased stripe rust development in triticales. The vulnerable long season varieties Jackie and Breakwell have been removed from recommendation due to stripe rust. Replacement varieties, including both long season dual purpose and mid season grain only types, have given a range of options for sowing resistant material. The stripe rust response of current triticale varieties was circulated in Cereal Rust Report Volume 7 Issue 1 (February 2009).

Triticale varieties Hawkeye and Endeavour have shown some evidence of mixed response to stripe rust. These varieties are rated as MR and R, respectively, although some plants have shown a susceptible response in field situations.

Tobruk triticale is a long season dual purpose type that was rated moderately resistant to stripe rust and represented a good alternative to Jackie. Tobruk was noted to be quite vulnerable to stripe rust in the early stages of crop establishment, although the resistant response became generally evident from tillering. However, recent experience in south east NSW (Holbrook to Culcairn, Cootamundra, Young) suggests that Tobruk has become susceptible in the current season. The photos in Plate 1 illustrate the levels of stripe rust damage in foliage and head infections that have been noted in field situations. Many crops have been sprayed for disease control. However, comments from several folk who have observed severely affected Tobruk crops expect that yield losses will be significant.

Stripe rust samples collected from Tobruk have been recovered and initial results indicate that the 'Jackie' pathotype is frequently identified. Further experiments are now underway to explore the hypothesis that the pathogen has undergone further pathogenic change that cannot be detected using current identification methods.

Plate 1 *Tobruk Triticale at Holbrook, NSW in 2009. Top view indicates stripe rust damage on the foliage and the lower image illustrates severe head infections in almost every plant. Note that the green heads are off-type plants.*
Photos courtesy of Janet Walker (I&I NSW, Albury) and Tony Geddes (Holbrook).

Head Infection

In addition to the severe infection in Tobruk triticale, there have been several recent reports of serious head infection in wheats. The following information, initially circulated as Cereal Rust Report Volume 1, Issue 1 (November 2003), will hopefully provide some background and approach to the management of head infection.

Symptoms

Bleached, discoloured florets with faint evidence of yellow rust spores can be seen from first inspection of suspect heads (see Plate 2). These symptoms may be initially confused with other diseases, such as Fusarium head scab.

Plate 2 *Bleached florets with traces of yellow rust spores evident in severe head infection*

Peeling back glumes from affected florets will reveal abundant yellow rust spores being produced on the inside of the floret adjacent to the developing seed (see Plate 3). The disease has in fact been referred to as glume rust, and the pathogen was once given the now obsolete name of *Puccinia glumarum.*

Plate 3 *Peeled glumes reveal "buckets" of spores adjacent to the developing seed*

Infection cycle

Spores germinate and infect florets from heading to flowering, with symptoms developing over the following 10 to 20 days. Infection does not occur after flowering. Conditions for spore germination are the same as those required for canopy infection: cool temperatures (optimally 8 to 12°C) and 100% humidity. In contrast to foliar infection, infected florets are unlikely to support further cycles of infection because spores are enclosed largely on the inside of the glume. However the encased spores may be liberated at harvest and move in air currents to infect available host plants, typically self sown wheat, and

so improve opportunities for pathogen survival between cropping seasons. Although spores may adhere to seed, they are not expected to survive for more than a few days. Stripe rust is not a seed borne disease.

Variety responses

There are observable differences in the response of varieties to head infection. In general, varieties resistant in the canopy will be resistant in the head; conversely, those susceptible in the foliage will tend to support a heavy inoculum load and head infection may become severe. However there are many situations where severe head infection has occurred despite moderate to low levels of rust in the crop canopy. This is due to high levels of inoculum that may be generated from crops adjacent to or nearby the unexpected head infections.

Anticipated impact on crop yield

It can be expected that head infection will produce shrivelled grain, although the extent of this will depend on how early the infection established in a particular floret and how many florets become infected. Screenings will be expected to increase with severe infections. Seed staining has been reported in severe cases of head infection. Note that the pathogen does not produce toxins that would prevent the use of downgraded seed as stock feed.

Control of head infection

Chemical control of head infection is not considered to be effective, despite the excellent levels of disease reduction that can be achieved with foliar sprays. This is due to poor, if any, translocation of fungicide from the flag leaf to the head, and poor coverage of chemical targeted for head control only.

Table 1. Pathotype determinations across regions and time periods in 2009. Note that this is preliminary data (early November 2009) with more samples awaiting analysis.

Region	'Jackie' Pathotype					'WA' Pathotype					'WA Yr17' Pathotype				
	Jun	Jul	Aug	Sep	Oct	Jun	Jul	Aug	Sep	Oct	Jun	Jul	Aug	Sep	Oct
Qld		7	16	6			2	2	1			2	1	2	
nNSW	1	27	29	6			6	4				7	16	7	
sNSW	1	1	28	30	2		1	4	1			2	7	16	1
Vic			4	2	4			1	2						1
SA			11	3	2								5	4	7
Totals	2	35	88	47	8		9	11	4			11	29	29	9
	180 (64%)					23 (8%)					78 (28%)				

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Rusted plant samples can be mailed in paper envelopes; do not use plastic wrapping or plastic lined packages. Direct samples to:

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